UNIVERSITI PUTRA MALAYSIA

ESTABLISHMENT, GROWTH PERFORMANCE AND SOME ASPECTS OF ECOPHYSICAL CHARACTERISTICS OF TWO RATTAN SPECIES: CALAMUS MANAN AND CALAMUS TUMIDUS

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by

AMINUDDIN BIN MOHAMAD

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Dedicated to

wife, NORLIA HJ. RAZALI

and kids,

AZMAN FIRDAUS

NUR AINUNNAZLI

AHMAD FAIZ

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LIST OF ABBREVIATIONS

CGP : Cumulative Germination Percentage

EP : Energy Period

FRIM : Forest Research Institute Malaysia

GC : Germination Capacity

GP : Germination Period

I.S.T.A. : International Seed Testing Association.

PFR : Pasoh Forest Reserve

RLI : Relative Light Intensity

SBFR : Sungai Buloh Forest Reserve

TRF : Tropical Rainforest

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An abstract of the thesis presented to the Senate of Universiti Pertanian Malaysia in partial fulfillment of the requirements for the Degree of Master of Science.

ESTABLISHMEMT, GROWTH PERFORMANCE AND SOME ASPECTS OF ECOPHYSIOLOGICAL CHARACTERISTICS OF TWO RATTAN SPECIES: *Calamus manan* AND *Calamus tumidus*

by

Aminuddin bin Mohamad

July 1987

Supervisor : Assoc. Prof. Mohd. Basri bin Hamzah

Faculty : Forestry

Rattans are indigenous spiny climbing palms and are considered to be the most important non-wood forest produce in Malaysia. In recent years, a tremendous increase in demand for rattans has outstripped natural supply consequently initiating large scale plantings. Although rattan research in Malaysia commenced in 1975, knowledge on its silviculture is still rudimentary. In this study, basic aspects of establishment, growth performance and ecophysiology of *Calamus manan* and *C. tumidus*, two of the more important indigenous species, will be elucidated as a basis to silvicultural application.

Three main studies were conducted; (i) germination, (ii) canopy manipulation and (iii) photosynthesis. The first was conducted at Forest Research Institute Malaysia (FRIM). The latter two were on field grown seedlings located at Sungei Buloh Forest Reserve and Pasoh Forest Reserve under secondary dipterocarp and at Dengkil, Selangor under established rubber plantation.

Only cleaned seeds (that is sarcotesta removed) were used in the germination. Both species, C. manan and C. tumidus followed the "adjacent ligular" germination characteristics and germinated in a wide range of light intensity (< 1% to 100% RLI) but for optimum germination, 10% to 20% RLI was preferred. C. manan was found to be a "rapid" germinator while C. tumidus "intermediate". The lack of dormancy in C. manan was inferred. The pretreatments imposed, that is (i) soaking in running tap water at ambient room temperature and (ii) placing in growth chamber set at 26 ^{o}C with continuous neon lighting and relative humidity at 74% for seven days reduced energy period for C. manan to one week but did not improve germination level. Sand was the best medium but sand-sawdust mix was preferred.

Field grown 4-year-old C. manan seedlings responded favourably to line opening of 1.8 m to 3.6 m width. For silvicultural application, the 1.8 m width is recommended. For 2-year-old C. tumidus seedlings, growth response to canopy opening was not apparent. Trends however suggest greater

response to N-fertilizer application (optimum at 170 gm per plant), than to canopy manipulation. Further observation is required.

The need for canopy opening at establishment is supported by recorded field assimilation rate. Both the species have low light saturation point (between 40 to 60 micro E m^{-2} s^{-1} or about 4% to 6% RLI) which suggests tolerance to deep shade, characteristics of forest floor species (< 1% RLI). Prolonged survival under deep shade suggests efficiency in species photosynthetic system utilising occasional sunflecks (measuring up to 200 micro E m^{-2} s^{-1}). Further growth and development is only possible above the 4% to 6 % RLI light saturation point which naturally occurs in gap openings.

Further investigations into the establishment and growth performance of both species were recommended; specifically, storage of seeds, other pretreatment techniques, fertilizer interaction between treatments for both species, timing of canopy opening and subsequent bioproductivity studies.

Abstrak tesis yang dikemukakan kepada Senat Universiti Pertanian Malaysia sebagai memenuhi sebahagian keperluan untuk Ijazah Master Sains.

ESTABLISHMENT, GROWTH PERFORMANCE AND SOME ASPECTS OF ECOPHYSIOLOGICAL CHARACTERISTICS OF TWO RATTAN SPECIES: *Calamus manan* AND *Calamus tumidus*

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Rotan adalah pepohon tempatan (indigenous) yang memanjat, mempunyai onak dan duri dan juga hasil hutan bukan balak yang terpenting bagi Malaysia. Sejak kebelakangan ini dengan meningkatnya permintaan telah mengakibatkan kekurangan bahan mentah dari hutan. Untuk mengatasi ini, cara tanaman secara berladang telah dirancangkan. Walaupun penyelidikan telah bermula sejak tahun 1975, namun pengetahuan silvikulturnya masih diperingkat awalan. Dalam kajian ini, aspek-aspek penyelidikan mengenai penubuhan, tumbesaran dan ekofisiologi bagi Rotan manau (*Calamus manan*) dan Rotan manau tikus (*C. tumidus*) dijalankan untuk menjawab persoalan silvikultur dari segi penggunaannya.

Tiga kajian utama dijalankan; (i) kajian kecambahan, (ii) pembukaan naungan dan (iii) fotosintesis. Kajian (i) dan (ii) dikendalikan di FRIM; iaitu dimakmal-makmal, tapak semaian dan kawasan FRIM. Bagi (ii) dan (iii) pula dijalankan dikawasan tanaman (ladang) FRIM iaitu di Sungei Buloh Forest Reserve dan Pasoh Forest Reserve didalam kawasan hutan dipterocarp dan juga dibawah dirian getah di Dengkil, Selangor.

Hanya bijibenih yang telah dibersihkan diguna dalam kajian (i). Kedua-dua spesis, Rotan manau dan Rotan manau tikus mengikut ciri-ciri kecambahan "adjacent ligular" dan boleh bercambah dibawah naungan cahaya yang luas (dari 1% hingga 100% RLI). Rotan manau boleh bercambah dengan cepat dan dikategorikan sebagai "rapid" (cepat) dan Rotan manau tikus sebagai "intermediate" (pertengahan). Didapati juga Rotan manau tidak mempunyai masa dormansi. Dari rawatan yang dijalankan keatas bijibenih; iaitu (i) rendam dalam air yang mengalir didalam suhu bilik dan (ii) simpan dalam "growth chamber" yang telah ditentukan mempunyai suhu 26 ^{o}C, kelembapan 74% dan lampu selama 7 hari. Didapati tenaga kecambahan (EP) dapat dikurangkan menjadi satu minggu tetapi kadar kecambahan tidak begitu memuaskan. Media pasir didapati media yang baik tetapi difikirkan percampuran pasir-habuk papan adalah sesuai.

Rotan manau yang ditanam sejak 4 tahun yang lalu didapati tumbuh dengan baik dibawah pembukaan naungan 1.8 m hingga 3.6 m

lebar. Adalah disyorkan pembukaan naungan 1.8 m digunakan. Bagi Rotan manau tikus, yang ditanam 2 tahun yang lalu, belum menunjukkan kesan lagi. Walau bagaimana pun, dari data-data tumbesaran didapati kesan baja (N-fertilizer sebanyak 170 gm) ada memberi kesan awal. Penelitian selanjutnya harus dijalankan.

Kajian ekofisiologi mengesahkan bahawa kajian pembukaan naungan adalah perlu bagi kedua-dua jenis rotan ini berdasarkan kepada kadar assimilasinya. Kedua-dua mempunyai ciri "low light assimilation point" (diantara 40 hingga 60 micro E m^{-2} s^{-1} atau 4% hingga 6% RLI) menggambarkan bahawa anakbenih rotan boleh hidup dalam keadaan yang kurang cahaya, iaitu ciri-ciri pokok-pokok yang berada dibawah dirian hutan.

Keupayaan hidup dibawah naungan terlalu lama menunjukkan rotan mempunyai sistem fotosintesis yang lancar (efficient) yang boleh mengambil kesempatan menggunakan "sunfleck" (sekitar 200 micro E m^{-2} s^{-1}). Tumbesaran akan hanya berlaku diatas paras 4% RLI dimana biasanya terdapat didalam jurang hutan (gap openings).

Perbincangan telah merangkumi semua aspek kajian dan cuba menerangkan ciri-ciri kedua-dua jenis rotan. Kajian selanjutnya telah dicadangkan merangkumi aspek-aspek tumbesaran yang lain dan juga interaksinya; umpamanya kajian penyimpanan bijibenih, cara-cara rawatan yang lain untuk penyemaian bijibenih, kajian rejim pembajaan dan interaksi dengan pembukaan naungan, masa yang sesuai untuk pembukaan naungan dan juga kajian bioproduktiviti.

CHAPTER 1

GENERAL INTRODUCTION

Rattans are spiny climbing palms comprising about 600 species concentrated in South East Asia. In Peninsular Malaysia, 104 species belonging to nine genera have been documented (Dransfield, 1979, 1980a). Of these, the most sought after are Calamus manan Miquel (Rotan manau) and Calamus caesius Blume (Rotan sega). C. manan is the large-diameter cane having sizes more than 18 mm in diameter while C. caesius is the small-diameter cane with less than 18 mm diameter.

Rattans enter the world market as rattan sticks, cane, core and split cane, and as raw materials for the construction of cane furniture. The rattan world trade is a multimillion-dollar venture. Trade in raw rattan amounts to about US$50 million in 1980 (Menon, 1980). Malaysia is considered as one of the exporters of rattan with about 10% of total world export in raw rattan world as compared with 73% from Indonesia (Silitonga, 1985). From a total of about 600 species found in the world, only about 20 species are being commercialised (Manokaran, 1985a).

In recent years, there has been a tremendous increase in demand for rattans for manufacturing and manufactured goods (Manokaran, 1976). This resulted in an increase in harvesting rate, thereby severely depleting supplies in the wild. The most important-large diameter cane, C. manan, has now become so depleted that another less valuable, cane C. ornatus Blume., is